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FRENCH BAUXITE PROSPECTION MISSION IN THE LOWER MEKONG BASIN

QUARTERLY REPORT

April - June 1962

By Dr. H. Cruys
Geologist of the French Bureau of Geological and Mining Researches,
Chief of Mission

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Geologist of B.R.G.M., Chief of Mission

I. INTRODUCTION

The present report gives an account of the work undertaken by the French Bauxite Mission for the period April through June 1962.

As established in its prospection programme, the Mission has pursued its investigations in limestone areas. A reconnaissance was made during the months of April and May in the vast limestone area of Kanchanaburi. The town of Kanchanaburi is situated at some 110 air km west of Bangkok.

Later on, a check for incidence of bauxite was made in lateritic area of Prachinburi - Prachantakam, which stretches to about 100 km NE of Bangkok.

Mr. Sidhi Sudddhibhongse, a geologist from the Department of Mines at Bangkok, served once again as our assistant and faithful companion on the field where he has rendered us a valuable service, which we highly appreciated, especially in rugged mountains and excessive heat of the last dry season.

A few weeks ago, we made a short visit to Phnom Penh where necessary arrangements have been made for bauxite prospection work to be carried out by us in Cambodia.

II. WORK UNDERTAKEN AT BANGKOK

Among the work undertaken at Bangkok we would like to mention the following:

(1) Study with the help of Pin-hole camera of aerial photos of the Kanchanaburi area. This study has enabled us to locate and to define some limestone areas which are of great interest on the geomorphological point of view, towards which reconnaissance work has been directed.

/ (2)

(2) Preparation of our detailed quarterly report for the period January-March 1962.

(3) Administrative work: preparation of monthly progress reports for the months from April through June 1962 for Mr. J. Lautard, Adviser for Asia and the Far East of the B.R.G.M. in Paris.

(4) Sorting of some forty samples of clay, lime tone and laterite taken from prospected areas. These samples will later be analysed in the laboratories of the B.R.C.M. in Paris, especially with the purpose of analyzing the contents of oxydes in the following elements: Aluminium, iron, silica, calcium, magnesium and titanium. It is possible that certain known deposits had been enriched with free alumina.

III. INVESTIGATIONS: GEOLOGY

A. Kanchanaburi area

Maps and photos:

(1) Topographic map at 1/250,000, Suphanburi sheet, ND 47-7, serial L-509
(2) " " " Thonburi sheet, ND 47-11, serial L-509
(3) " " " Tavoy sheet, ND 47-6, serial L-509
(4) Aerial photos (approximately scale 1:40,000) Nos.2818-2832,2470-2484, 2428-2443, 1895-1910, 1818-1834, 1862-1876,1680-1694, 1788-1802, 1225-1238, 840-858 & 1198-1215.

1. Mae Klong Area downstream of Kanchanaburi (Annex, Photo Nos. 1-13)

Accompanied by Mr. Kaset Pitakpraivan, Chief of the Geological Section of the Department of Mines, we also made a check, by boat, of the tributaries of the Mae Klong river between Kanchanaburi and the village of Tha Muang and, further downstream, between Tha Muang and Ban Tha Rua. The distance from Kanchanaburi to Tha Rua is about 40 km along the river which curves into many big meanders.

We may recall in this context that Mr. Richardson had observed the presence of bauxite in this area, especially at Tha Muang and at a point situated halfway

/ between

between Kanchanaburi and Tha Muang (Bibliography No.1: Bibliography + Annex III-a) However, the observations made by Mr. Richardson had not been varified by chemical analyses. We can nevertheless now confirm the conclusions of Messrs. Kaset Pithakpraivan and Nitipat Jalichan who, during the visit they made in 1948 in the same area of the river Mae Klong, have noticed that the bauxite, as observed by Mr. Richardson, is in fact chalk-stones, the analysis of which has shown content of only 3.7% of Alumina (Bibl. No.1: Bibliography + Annexes III-b and III-c).

During the reconnaissance we made, we have found out that they are more or less hard chalk-stones of diffirent shades from whitish to greyish, beige yellowish and pinkish colors. They present themselves in the form nodules at various levels and often form veritable banks amid recent clay and sand deposits of the river which are yellow and grey in color. These river deposits, which are usually chalk-stones, outcrop over great distances along the bank of the river, terraces, which, during the dry season shows beautiful profiles in the form of cliffs, the height of which varies from 4 m to 10 m (Annex, Photos No. 1-13).

We have studied many of these outcrops and have taken samples at different levels. Some of the samples will be analysed for information purpose.

2. Area north of Mae Klong (Kwae Yai) - (Appendix, Photos No. 14 - 22)

The investigated area NW and NNW of Kanchanaburi is a vast mountainous area, with a N-S alignment both on the structural and topographical points of view. Geologically the area is characterized by a series of paleozoic sediments, criss-crossed by granitic masses of the mesozoic age stones. The paleozoic sediments are represented by clay and karstic schists of the "Kanchanaburi range" and by limestone and dolomitic formations "Thung Song" especially that of "Ratburi" of silurian age, respectively permo-carboniferous.

It is in particular the limestone and the domomitic limestones which are affected by the metamorphism of contact caused by intrusive granites, thus creating important outcrops of crystalline limestones in which are often found metamorphic silica such as epidote, grossularite, wollastonite and diopside.

/Through

Through a prior study of aerial photos we have found some karstic and tabular reliefs which are worth prospecting. They are found in area situated NW of Kanchanaburi and in the vicinity of Um Krum area where a large iron-one prospection camp of the Department of Mines is erected at about 60 air km NNW of Kanchanaburi (Appendix, Photo No. 18).

(a) Khao Chao Daeng (Appendix, Photos No. 19 and 20)

It is a large hill which raises to an altitude of more than 200 m in the plain which stretches south of Um Krum. This relief is generally constituted by crystalline and karstic limestone (Lapiaz type) belonging to the "Ratburi" formation. The contact metamorphism is caused by a granitic intrusion, some outcrops of which are observed on the southern flank of the relief.

The central part of the Kahao Chao Daeng is occupied by a deep dolina almost of a circular form, and of a diameter of about 500 m, whose subhorizontal bed is covered with red and red brown clay of the "terra-rossa" type. There, we have found very localized small crusts of red ferruginous and clayey laterite. Along the edge of the dolina, where the terra rossa cover is partially hollowed-out by the present erosion, appear many small outcrops of metamorphic limestones.

No bauxite incidence has been observed there.

(b) Kha Khanung is a range of N-S bearing high mountains, composed of porphyroid granites (Appendix, Photo No. 22) which intrude in limestones and paleozoic and clayey schists. It is located at about 10 to 15 km SW of Um Krum. On the slope of this big mountains relief, which rises to an altitude of nearly 1000 m, we have prospected some large ledges which stretch laterally and which are chiselled in crystalline limestone formations. There are likely to exist in a "hanging roof" position resting on a granitic base.

The mountain does not bear any trace of laterization.

/ (c) Khao

(c) Khao Salop-Khao Phu Khwai-Khao Long is a vast plateau which rises to an altitude of about 400 to more than 500 m in comparison with that of Kanchanaburi (see also Appendix, Photo No. 14).

This plateau is composed of limestones and dolomitic limestones of grey-blue ou dark grey colour, more or less metamorphic, belonging to the silurian rocks of "Thung Song".

This limestone formation is affected by superficial karst: Lapiaz and dolina.

The plateau is covered in greater part with red, brown and red-brown soils of the "terra rossa" type, but there were no lateritic formations.

3. Kwae Yai - Kwae Noi area (Appendix, photos Nos. 23-30)

In the NNW-SSE oriented area between the subparallel valleys of Kwae Yai (Mae Klong upstream of Kanchanaburi) in the north, and of Kwae Noi in the south, we have visited the high reliefs of Khao Phlai and Khao Chong Krathing which belong to one of the most important limestone hills in the basin of the two rivers (Appendix, Photo No. 28).

This main group of mountain stretches to about some 25 to 45 km WNW of Kanchanaburi. Its altitude varies from some 400 m to 800 m compared with the altitude of Kanchanaburi. It is composed of massive limestone or limestone layers grey and beige in colour, spathic and very organogenous in nature (especially with encrinus and polypary) of the "Ratburi" permo-carboniferous formation. This is the case of a karstic group of mountain, especially characterized by the presence of grottoes and large dolinas, and further, bordered by a vast plateau which represent a veritable surface of tropical karst dominated by moderately high gulleys (peak karst).

On the Khao Phai and Khao Chong Krathing mountains, we have prospected some important dolinas and the plateau itself (Appendix, Photos No. 29 and 30), but no incidence of bauxite has been observed there, nor were there any lateritic

/ formations.

formations. The bottom of the dolinas bear a curtain of red and brown-red clayey soils of the type of "terra rossa". On the valls of the dolinas were found "rendzina" soils black and brown-black in colour which usually accompany large limestone outcrops non-weathered or partially weathered and superficially karstified, in the form of lapiaz. On the high plateau we have observed that large flat areas with high tropical forest, between the numerous gulleys whose abrupt flanks are usually covered with a poor bamboo vegetation, are also covered with decalcified clay of red-brown colour.

4. Kwai Noi Valley (Appendix, Photos No. 31-51)

The Kwae Noi valley, which is bordered on both sides by high karstic limestone mountains (Ratburi formation), has been studied since 1960 by a pre-historic expedition composed of Danish, Thai and Dutch archeologists (Bibl. No. 2 and 3). Several limestone grottoes, often with beautiful stalagtites and certain locations of the river terraves bear interesting vestiges of the ancient man, especially: stone tools, pottery, objects d'art, bones and fossile skeletons.

We have made a rapid reconnaissance on the Kwae Noi, especially near Wang Pho (a village located at some 60 km upstream of Kanchanaburi) and by boat on a distance of some ten km upstream of Wang Pho. We have visited some of the grottoes, but we have not found there any incidence of bauxite-bearing laterite, nor at the foot of the karstfied slopes of the various limestone mountains. The bottom of the grottoes are usually filled with clay and limestone gravel.

B. Prachinburi-Prachantakam Area

Maps:

(1) Topographic map at 250,000, Ayuthya Sheet, ND 47-8, Serial L-509
(2) " " " Bangkok Sheet, ND 47-12, Serial L-509
(3) " " " Battambang Sheet, ND-48-9, Serial L-509

In 1957 and 1958, a group of engineers from a German Company "KRUPP" made a prospection for iron-ore incidences in Thailand. This survey was also supposed to made on certain formations of ferruginous laterite, especially on those in the Prachinburi-Prachantakam area (see Bibl. No.4: Text and Appendix III).

/ After having

After having been informed by Mr. Pisoot Sudasna, Chief, Technical Mining Division of the Depatment of Mines, and by the engineers from KRUPP Company, whom we met the other day at Um Krum camp, on the importance of lateritic crusts in the Prachinburi-Prachantakam area, we have gone there to verify the existence of bauxite-bearing laterite.

We have examined the laterites in 5 sub-areas of "Prachinburi West" and areas of "Prachinburi East" and those of "Prachantakam" which have all been investigated by the KRUPP mission, but we failed to trace any sign of bauxitization there. These laterites are ferruginous, quartzous and clayey at all levels.

The lateritic crusts form a succession of remarkable tabular reliefs, slightly inclined towards the south, of only a few meters in height and more or less large in area. These mountains are covered with forest and are in general not cultivated. They are separated from each other by large ricefields which belong to the plain in the basin of the Prachin River. This basin is bordered in the north by high hills and by plateaux composed of hard and very resistant sandstone of the Khorat range.

We do confirm the conclusions reached by Krupp's engineers as to the genetic nature of the laterites. They are in fact genuine lateritic shells formed by ferrallitic alteration "in situ" of the crystalline base. On the edges of the lateritic mountains, bordering on the ricefields, and in deep wells, used by local populations, we have found that the lateritic crusts, 3 to 4 m thick on the average, become more clayey and more kaolinic towards the bottom, and that they rest on residual clays, which are very kaolinic and quartzous, of the decomposed base. These clays have an impermeable bottom. This makes the water body of the area concentrate at the base of the lateritic elements. These are often covered with a layer of alluvium which is sandy and clayey in nature.

/ It is

It is probable that the various shells correspond to the weak part of the mountains, more or less laterized, of the regional base, with N-E bearing, smoothered by recent erosion. During our short visit of the area, it was not possible for us to make a thorough study of the regional base, but, according to more detailed observations made on the field and in the laboratory by the KRUPP's engineers, this base must be composed mainly of metamorphis rocks, very quartzous, injected at places by effusive basic rocks with epidote. In fact, this crystalline ensemble could, by no means, represent a good mother-rock propitious to the formation of very aluminous laterite.

Several chemical and physical analysis were made in laboratoiries of the KRUPP Company on samples of laterite and clay which systematically taken during the prospection for iron ore made in 1958 in the Prachinburi-Prachantakam area. But the results obtained from these analyses do not show any incidence of bauxite. The laterites are as always very ferruginous, quartzous, while their content in alumina varies only between 10 and 23%.

The various shells which are present in the Prachinburi-Prachantakam area, cover, according to KRUPP Company's investigation a total area of about 6 km2 with a possible reserve of some 20 million tons of ferrite.

We may add that while we travel along the Prachinburi-Prachantakam-Kabinburi Highway eastward to Aranya Prathet, we have observed in some vast lowlands of the Prachantakam-Kabinburi area still many more lateritic shells, which are larger in area and of greater importance than those in the Prachinburi-Prachantakam area. But here again, the laterites observed, are as always, very ferruginous and quartzous, with no incidences of bauxite.

We have also sampled the limestone-clay deposits which outcrop on the area of Aranyaprathet, in the holes near the main highway. These deposits, probably sedimentary in nature, are locally recovered with a crust of laterite, very ferruginous, quartzous and clayey.

/ IV.

IV. CONCLUSIONS - PROGRAMME

Reconnaissance we made during the months of April, May and June, were aimed at continuing the survey on possible incidence of bauxite in the central part of Thailand. But they do not, as always, show any convincing signs.

We will have to await the results of chemical analyses now being made, or to be made in the near future, in the laboratories of BRGM in Paris and of the Department of Mines in Bangkok, on about ten samples which were sorted out to determine whether some of them would show encouraging content in free alumina and whether, by way of consequence, it would be justified to carry out a more detailed investigation in the furture.

We shall leave Bangkok on 7 July to spend a leave of about three months in Europe.

In a week time, we shall meet with Mr. J. Lautard in Paris to discuss with him the details of our next programme.

Recently, we have already made a visit to Phnom Penh with the view to organizing the bauxite prospection Mission which will carry out the work we may have to do in Cambodia upon our return to the Mekong area.

/ V.

V. BIBLIOGRAPHY

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(3) H.R. Van HEEKEREN: A preliminary note on the excavation of the Sai-Yok rock-shelter (The Journal of the Siam Society, Vol. XLIX, fasc. 2, November 1961, p. 99-108)

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Sgd: H. Cruys

Bangkok, 3 July 1962

APPENDICES - Photos Nos. 1 - 51

APPENDICES - Quarterly Report - Period April - June 1962 (Bauxite Mission in Thailand)

PHOTOS

KANCHANABURI AREA

1. Mae Klong Area downstream of Kanchanaburi

Photos 1 and 2 : Khao Chamuk Pla Krai, limestone and karstic mountains (Permo-carboniferous formation "Rathburi") rising on the right Bank of the Mae Klong river between Kanchanaburi and Tha Muang.

/ Photos 2.3

Photos 2,3 and 4: Alluvial terrace on the right bank of the Mae Klong River, at the Northern foot of limestone mountain of Khao Chamuk Pla Krai. Continuous important outcrops consisting of recent river deposits: sand, quartz with traces of mica, clay, fine and coarse, grey and yellow-brown in colour, with small layers of gravel with heterogenous elements. The sediments are covered with a pedological upper layer of yellow sandy clay of some meters in thickness.

Photo 5 : Right bank of the Mae Klong River, just downstream of the village of Ban Tham: Sandy clay river deposits of recent formation, containing numerous limestone concretions, white, grey, beige, yellow and pink in colour.

The shingles of these limestone concretions are found in large quantities on the present gravel bars which outcrops on the foreground of the photo. The villagers are working on bamboo cleaning they operate on the large terrace and on the slope of the mountain.

Photos 6 and 7 : Right bank of the Mae Klong River, at level of small village of Ban Khlang: the abrupt edge of the river terrace presents a beautiful profile, of some meters in height, showing an important deposit of recent clay, grey and yellowish in colour, of limestone and fine sand (quartz and mica mostly), numerous layers of which were hardened by the presence of limestone in grey-white concretion. The latter also form veritable small banks, more or less continuous, within clay deposit.

Photo 8 : Alluvial terrace on the left bank of the Mae Klong River, downstream of Ban Khlang: huge continuous profile showing layers of hard limestone concretions within recent river sandy-clay deposit.

Photo 9 : Photo taken slightly above water surface level. It shows hard limestone concretions in dissicated clay.

Photo 10 : Alluvial terrace on the left bank of the Mae Klong River, upstream of Ban Tha Muang. In this huge river sandy-clay deposit outcrop many banks composed mainly of hard limestone concretions.

Photo 11 : Left bank of the Maw Klong River, Terrace at village of Tha Muang, which is continuation of profile in previous photo. Same aspects are observed at Tha Muang: sandy-clay sediments with numerous limestones concretions.

/ Photo 12

Photo 12: Right bank of Mae Klong River, at about 1 km downstream of the Tha Muang. In the section of sandy-clay silt of the river was sandwiched a layer of whitish clayey-limestone or pale grey clayey limestone 1 to 2 m thick, mixed with coarse quartz grains. Right below this limestone layer, which outcrops at about 100 m, was found (see left end of photo) every hard payer of quartzous ferrite, dark brown to blackist in colour, which rests itself on a thick layer of grey sedimentary clay. This laterite which is very ferruginous was likely formed by the absolute accumulation of iron oxydes, which were localized on the impermeable clay substratum of the alluvial terrace.

Photo 13: Right bank of the Mae Klong River, at the level of the small village of Ban Mai, downstream of Tha Muang. In the sandy-clay silt deposit of the river, of recent formation, is sandwiched a layer of hard clayey-limestone, white to grey-white in colour, 40 to 60 cm thick, which stretches further downstream over a distance of more than 100 m.

2. Area north of the Mae Klong (Kwae Yai)

Photo 14: The photo was taken towards the NW direction on the highway at 16 km from Kanchanaburi to Khao Chon Kai. Mountain on the middle ground of photo is found by clay schists of the paleozoic formation of "Kanchanaburi". On the background: Kao Long Plateau of the silurian limestone formation of "Thung Song". This plateau rises to an altitude of about 400 m above the Kanchanaburi level.

Photo 15: Bad condition of highway on southern foot of Khao Chon Kai following a violent rainstorm.

Photos 16 and 17: Residual limestone peaks, very typical, rising above the plain north of Kwae Yai, in the region west of Khao Chon Kai.

Photo 18: Site of the huge prospection camp of Um Krum of the Department of Mines. A mining and geological mission of the German KRUPP Company made a detailed investigation for iron ore incidence in the area of Um Krum.

/ Photo 19

Photo 19: Eastern slope of Khao Chao Daeng at 10 km south of Um Krum

Photo 20: Southern slope of Khao Chao Daeng. This remarkable slope is crowned with high limestone cliffs more or less metamorphic in nature.

Below, on the stiff slope, outcrops and mass of fallen earth of an intrusive leucocrate granite are found. The arrow indicates the southern edge of the big donila of the central part of the high mountain.

Photo 21: View of the northeastern part of the dolina which is characteristic of the central part of Khao Chao Daeng. The subhorizontal bottom is covered with red and red-brown clay of the "terra rossa" type.

Photo 22: View of one of the big outcrops of porphyroid granite on the Khao Khanung Mountain.

3. Kwae Yai - Kwae Noi Area

Photo 23: The railway from Kanchanaburi to the valley of the Kwae Noi, a big tributary on the right side of the Kwae Yai (= Mae Klong upstream of Kanchanaburi).

In the background: High karstic limestone mountain of the range of Khao Phu Liap-Khao Phu Sang Khlaeng, west of Kanchanaburi on the right bank of the Kwae Yai.

Photo 24: The Kwae Yai River and the ancient location of a large "Bridge of the River Kwai". The view is taken at the present railway bridge, at some 2 km upstream of Kanchanaburi.

Photo 25: View of the Kwae Yai River, near the village of Ban Tha Sao, some 20 km upstream of Kanchanaburi. In the background: the limestone mountain of Khao Phu Liap-Khao Phu Sang Khlaeng.

Photo 26: View of the northern slope of the big limestone range of Khao Phu Liap - Khao Phu Sang Khlaeng.

Photo 27: The "ferry" large bamboo raft on the Kwae Yai near the villages of Tha Manao and Yokobat at some 35 km upstream of Kanchanaburi.

/ Photo 28

Photo 28: View of the northern slope of the big limestone mountain, very karstic of Khao Phu Mai Daeng - Khao Phlai-Khao Chong Krating-Khao Ban Klang

Photo 29: The Khao Phlai mountain, formed by "Ratburi" type limestone. The arrow indicates the northern edge of a deep dolina of about 500 m in diameter, chiselled in karstified limestone on the northern part of the plateau of the Khao Phlai. The picture was taken at dawn: Fog was still hanging over the valley of the Kwae Yai.

Photo 30: View of the big dolina found on the Khao Phlai. The bottom is filled with the "terra rossa" type clay.

4. The Kwae Noi Valley

Photos 31, 32, 33: View of the valley of the Kwae Noi between Kanchanaburi and Wang Pho.

Photo 34: View of the railway in the valley of the Kwae Noi near Wang Pho. On the right one can see a spur of the southern slope of the karstic limestone mountain of Khao Chong Krathing.
In the background: northern slope of the limestone mountain of Khao Kwang, on the right bank of the Kwae Noi upstream of Wang Pho.

Photos 35,36 Very karstic eastern part (with peaks, dolinas and grottoes) of Khao Kwang, above the Wang Pho village.

Photos 37,28 Entrance of limestone grottoes on the southern slope of the Khao Chong Krathing, on the left bank of the Kwae Noi, near Wang Pho.

Photos 39,40 41,42,43,44 and 45 : Outcrops of massive limestone (belonging to the permo-carboniferous formation of "Ratburi") and view of various karstic mountains with very characteristic limestone morphology (peaks dolinas and wall-like slopes) on the right and left banks of the Kwae Noi, upstream of Wang Pho over a distance of some 10 km.

Photos 46, 47 and 48: Curious formations of stalagtites on the walls of some of the high limestone mountains on the Kwae Noi, upstream of Wang Pho.

Photos 49 and 50: Some views of the complex large groto "Lawa" on the right bank of the Kwae Noi, upstream of Wang Pho.

Photo 51: Bamboo exploitation on the Kwae Noi.